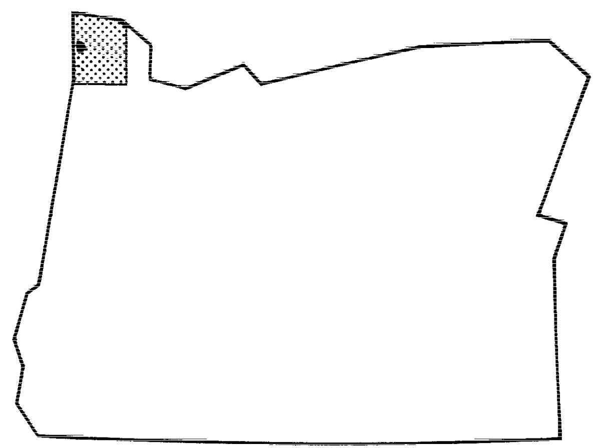
FLOOD INSURANCE STUDY

CITY OF SEASIDE, OREGON
CLATSOP COUNTY



MARCH 1979

U.S. DEPARTMENT of HOUSING & URBAN DEVELOPMENT
FEDERAL INSURANCE ADMINISTRATION

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FLOOD INSURANCE STUDY

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the City of Seaside, Clatsop County, Oregon, and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Seaside to the regular program of flood insurance by the Federal Insurance Administration. Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

The community base map was selected, and streams requiring detailed study were identified in meetings attended by personnel of the U.S. Soil Conservation Service, the Oregon Water Resources Department (State Coordinating Agency), the Federal Insurance Administration, and the City of Seaside in March 1975.

Analysis of coastal flooding was conducted by the firm of CH2M HILL, Inc., while analysis of riverine flooding was done by the U.S. Soil Conservation Service.

During the course of the work on this study and the previous work done by the U.S. Soil Conservation Service on the Necanicum River, this work was reviewed with community officials and officials of the Oregon Water Resources Department.

On July 13, 1978, the results of work done by the U.S. Soil Conservation Service were reviewed at final coordination meetings attended by personnel of the U.S. Soil Conservation Service, the Federal Insurance Administration, and the office of the City Engineer. All problems were resolved as a result of these two meetings.

1.3 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for the Necanicum River, Neawanna Creek, and Circle Creek were performed by the U.S. Soil Conservation Service for the Federal Insurance Administration, under Inter-Agency Agreement No. IAA-H-18-75, Project Order No. 7. The hydrologic and hydraulic analyses of the Pacific Ocean were performed by CH2M HILL, Inc., for the Federal Insurance Administration, under Contract No. H-3803. All this work, which was completed in July 1976, covered all the significant flooding sources affecting the City of Seaside.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Seaside, Clatsop County, Oregon. The area of study is shown on the Vicinity Map (Figure 1).

Floods caused by overflow of the Necanicum River, Neawanna Creek, and, Circle Creek, and by the coastal astronomical tides on the Pacific Ocean were studied in detail. Flood levels given in this report are considered to be water conditions as they existed in December 1976.

A small area of Clatsop County in the southern section of Seaside was not included in this study.

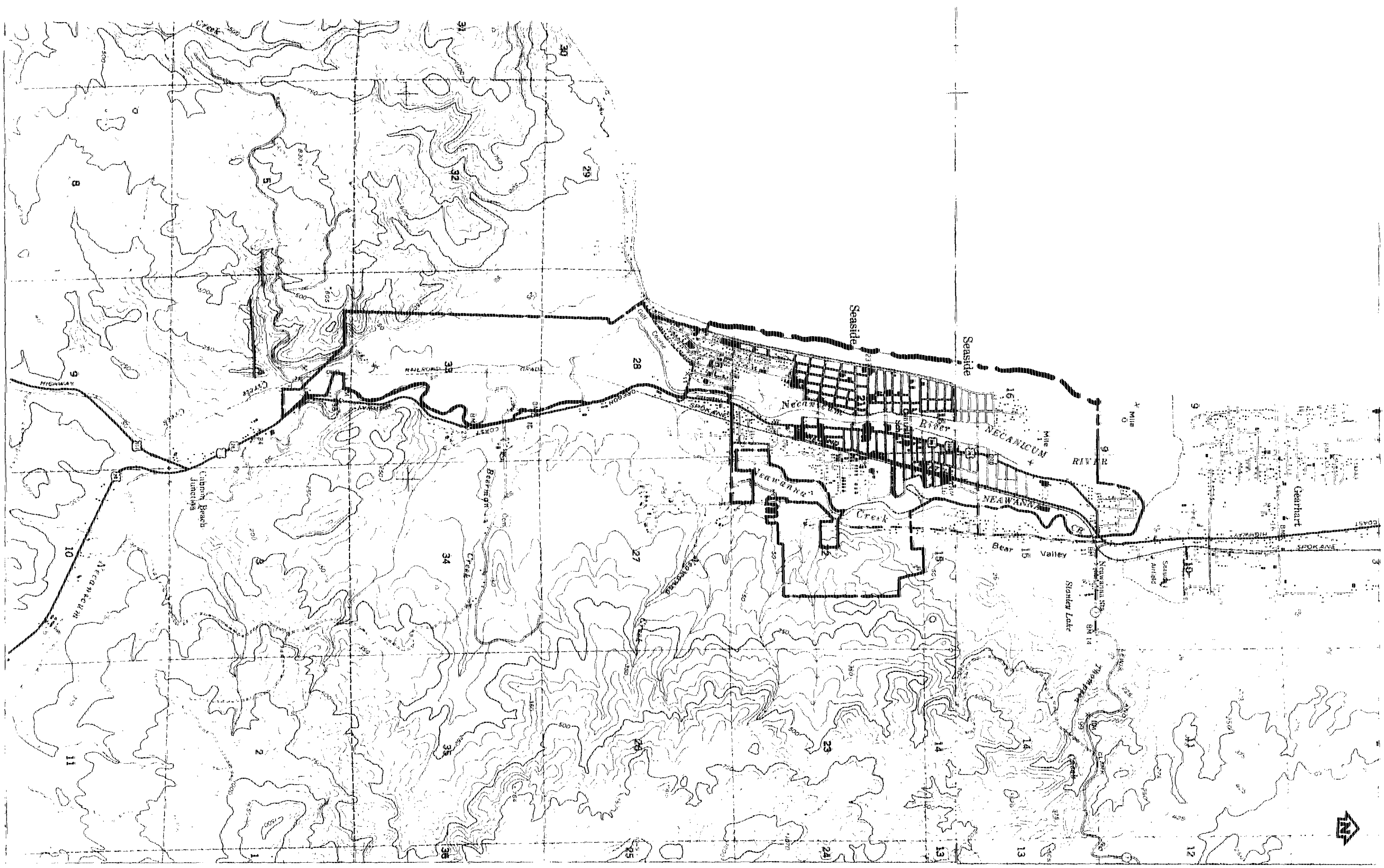
Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1981.

2.2 Community Description

The City of Seaside is located on the west-central border of Clatsop County, in northwestern Oregon, and lies along the Pacific coast on the west slope of the Coast Range. It had a population of 4620 in 1974, an increase from 4402 in 1970 and 3877 in 1960.

The economy of the area is based on logging and recreation. The ocean beach at Seaside is probably the most used beach on the Oregon coast. Weekend recreation and summer tourism also contribute to Seaside's economy.

The Necanicum River drains approximately 68 square miles on the Pacific Ocean side of the northern Coastal Range. It flows 18 miles in a generally northwestern direction to within 0.25 mile of the Pacific Ocean, then flows north for approximately 3 miles, before turning west to empty into the ocean. The lower 3 miles are separated from the ocean by a sandspit, ranging from 0.25 to 0.50 mile in width, forming part of the City of Seaside. There are 1.8 miles of ocean front within Seaside.



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APPROXIMATE SCALE
4000 0 4000 8000 12000 FEET

VICINITY MAP

FIGURE 1

In its lower reaches, the Necanicum River is joined by several tributaries. These streams meander through farmlands, then flow through Seaside to the ocean.

Neawanna Creek flows from the east, meanders along the valley floor through Seaside, and joins the Necanicum River in the bay area, approximately 0.5 mile upstream from the Pacific Ocean.

Circle Creek flows from the south, meanders along the Necanicum River valley floor, and joins the Necanicum River at the Seaside Golf Course.

A lowland area of Clatsop County, known as the Clatsop Plains, extends along the Pacific coast from the Columbia River south to Seaside. It varies in width from 1 to 2 miles. The alluvial terraces of the east side of the Clatsop Plains are gradually replaced by a series of parallel beach ridges and sand dunes near the Pacific Ocean (Reference 1).

Due to the moderating influence of the Pacific Ocean, Seaside has cool summers and mild winters. Approximately 80 percent of the precipitation occurs during the months of October through March. Average yearly precipitation is 79.70 inches. Average temperature ranges vary from a low of 43.4°F to a high of 60.1°F (Reference 1).

The dominant forest species in Clatsop County is western hemlock, with Douglas fir and Sitka spruce trees ranking second and third, respectively (Reference 1). The City of Seaside is characterized predominately by an urban-type vegetation.

The flat flood plains and low terraces contain approximately 20 percent of the city's commercial and residential structures.

2.3 Principal Flood Problems

Low-lying areas of Seaside are subject to periodic flooding caused by overflow of the Necanicum River, Neawanna Creek, and Circle Creek. The flood season begins in October and extends through April, with most of the larger floods occurring during December and January. They generally cause flooding throughout the watershed area and within the City of Seaside.

Severe floods are caused by an adverse combination of climatic conditions. During the most intense rainstorms, the freezing level often rises to 10,000 feet or more in the mountains, causing significant melting of accumulated snow in the Coast Range when the ground is near saturation. The runoff is great and rapid. In addition, onshore winds may raise tides higher than predicted and block the river outlet.

During flood stages, the streams cause severe damage from overbank flooding and streambank erosion. Log jams and deposited debris also cause considerable damage. During high floods, the Necanicum River overflows its banks and flows west into the Circle Creek flood plain. This happens at various locations from above the corporate limits northward to the Seaside Golf Course. From Peterson Point north to the Seaside Golf Course, floodwater from the Necanicum River overflows U.S. Highway 101 and into the Beerman Creek flood plain east of the city. This floodwater then flows north into Neawanna Creek and into the city. Floodwater from Necanicum River also flows eastward under Dooley Bridge into the Neawanna Creek flood plain.

The more significant floods that have occurred in the past 30 years occurred in February 1949, February 1961, January 1964, December 1964, and January 1966. The most severe recorded flood was in February 1949. This flood caused extensive damage and is remembered by many residents.

Flood damage in tidal and coastal areas is a result of high stillwater levels and wave action. The stillwater level is caused by astronomical tides (caused by gravitational effects of the moon and sun) and storm surges (rise in water levels due to wind stress and low atmospheric pressure). Wave action produces a rise in water level, due to shoreward mass transport of the water, which is called wave runup or setup. In addition, wave runup, after breaking, produces flooding, and the velocity of the wave causes damage above the stillwater level of the flood.

The results of studies on tsunamis were not available at the time of this report.

The most significant flood events occur during the winter months, from October through April, when the astronomical tides are the highest, therefore, causing the larger, more frequent storms to occur.

Flood damage has been particularly severe when high tides and heavy runoff occur simultaneously, because floodwaters from higher watershed areas are temporarily dammed by the tidal effect in the lower reaches of the river.

The northern Oregon coast, like other coastal regions adjacent to the Pacific Ocean, is subject to tsunami (tidal wave) action created by submarine earth movements. The disastrous Good Friday Earthquake in Alaska on March 17, 1964, caused widespread tsunami conditions and caused $41,000 damage to the City of Seaside and $235,000 damage to private property in the Seaside area. Flood elevations in this report do not include the runup from tsunami waves.

2.4 Flood Protection Measures

The coastal shoreline of Seaside is protected by a seawall, except for a portion at the south of the city where a rockpile wall has been installed. These protections, along with the extensive beach area built up during the last 50 years and regulations forbidding the removal of sand from the entire beach, will protect most of Seaside from storms smaller than or equal to the 100-year frequency. No flood plain management measures have been undertaken in the City of Seaside.

3.0 ENGINEERING METHODS

For flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Floods having recurrence intervals of 10, 50, 100, and 500 years have been selected as having special significance for flood plain management and for flood insurance premium rates. The analyses reported here reflect current conditions in the watersheds of the flooding sources.

3.1 Hydrologic Analyses

The hydrologic analyses for Seaside were divided into two parts, coastal and riverine.

Flood damage in tidal and coastal areas is caused by stillwater levels and wave action. The stillwater level is a result of astronomical tide (caused by gravitational effects of the sun and moon) and storm surge (rise in water levels due to wind stress and low atmospheric pressure). Wave action also produces a rise in water level due to shoreward mass transport of the water. This is wave setup. After breaking, wave runup produces flooding; the energy of the wave produces damage above the stillwater level of the flood.

Coastal flooding may also be caused by tsunamis. The U.S. Army Corps of Engineers at the Waterways Experimental Station, Vicksburg, Mississippi, is under contract with the U.S. Department of Housing and Urban Development to determine flood levels on the Pacific Coast due to tsunamis. The results of this study were not available at the time of this report and will be incorporated at a later date.

Most significant flood events due to astronomical tide and storm surge occur during the period from November to March. Therefore, an astronomical tide height histogram was computed for this period using hourly predicted tides (Reference 2), which were calculated from tide tables (Reference 3).

Surface weather maps at 3-hour intervals for the period from 1942 to 1975 (Reference 4) were used to compile statistics on significant storm-producing events on the northern Oregon coast. These data were separated into three wind direction classes so that appropriate wave statistics could be combined with storm surge statistics generated with a storm surge model.

The storm surge-frequency distributions for the three wind directions were computed from a population of the highest storm surges for three reaches on the northern Oregon coast in the period from 1942 to 1975. The three reaches were from the Columbia River to Cape Falcon, from Cape Falcon to Cape lookout, and from Cape Lookout to Depoe Bay. These storm surge heights were computed using weather data obtained from 3-hour interval weather maps (Reference 5).

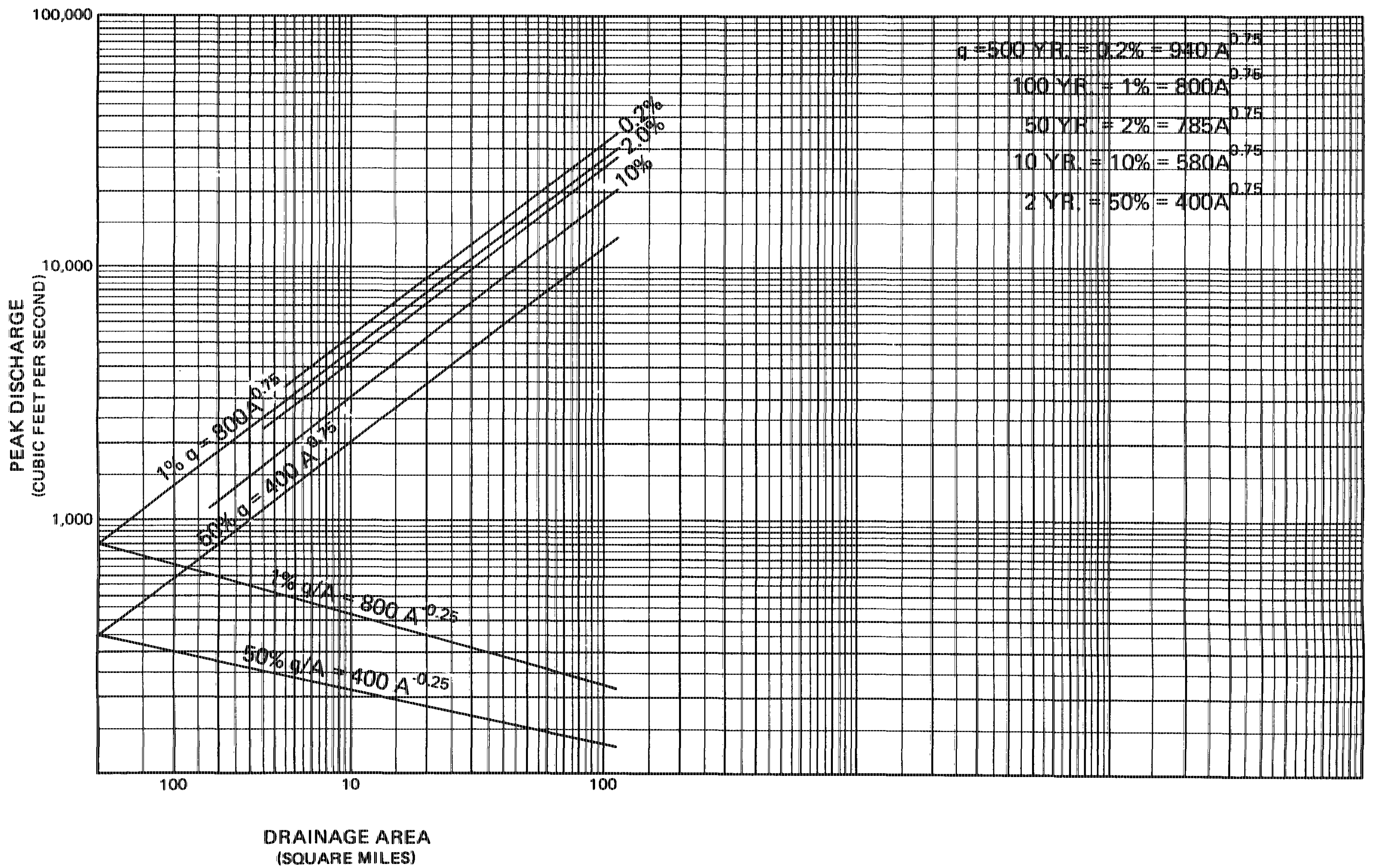
Wave statistics for coastal wind-generated waves, called sea, were computed using the Sverdrup-Munk-Bretschnieder procedure (Reference 6). The frequency distributions of wind waves for the three direction classes were computed from wave heights calculated using pressure gradients taken from the weather maps of significant storm events. Surface winds were computed from a modified version of the geostrophic wind equation. For the same direction class, wind waves of a certain probability were assumed to take place with a storm surge of the same probability because the same meteorological conditions produce both.

Waves produced by storms not directly affecting the coast, called swell, were computed by correlating the sea and swell wave height using the wind wave distributions referenced in the preceding paragraph. This assumes that delay and travel of the offshore wind waves (causing swell on the coast) do not significantly distort the shape of these probability distributions.

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each stream studied in detail in the community.

Streamflow measurements are not available for the Necanicum River, Neawanna Creek, and Circle Creek. In order to determine a relationship between floodflows and drainage areas for the study area, a regional analysis of 70 stream gages in the Northwestern United States coastal area was made by the U.S. Soil Conservation Service using standard methods.

This analysis was used, along with regionalization procedures of the U.S. Geological Survey (References 7 and 8), the U.S. Army Corps of Engineers (Reference 9), and the Oregon State Engineer (Reference 10), to determine peak discharge-drainage area relationships for the Necanicum River, Neawanna Creek, and Circle Creek. These relationships are shown in Figure 2.



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FREQUENCY-DISCHARGE, DRAINAGE AREA CURVES

NECANICUM RIVER, NEAWANNA AND CIRCLE CREEKS

FIGURE 2

3.2 Hydraulic Analyses

The hydraulic analyses for Seaside were divided into two parts, coastal and riverine.

Along the ocean coastline of Seaside, the stillwater level was calculated by combining the astronomical tide height and storm surge height. The storm surge height was computed using a computer program called COAST, which was constructed by rewriting the National Weather Service Program SPLASH Part 2 (Reference 11) to accommodate Pacific Northwest coast storm types. The offshore water depth at each point in a two-dimensional grid was input to the program. One side of the grid coincides with the coastline. Atmospheric pressure and pressure gradient fields were also specified in the grid area. Other parameter values for the program were obtained from numerical computations (Reference 12) and through trial-and-error calibration to match observed winds and high-water marks from past storms.

Pressure fields input from representative surge-producing storms of the last 32 years were placed into the computer model COAST for calculation of storm surge magnitudes on the northwest Oregon coast. Height-frequency relationships for three storm wind direction classes were calculated.

The astronomical tide and storm surge were combined by superimposing hourly values of storm surge and astronomical tide throughout the period of October 15 to March 15. An examination of observed surges from tide gage records indicated that the average time-height distribution of the various recurrence interval storm surges could be approximated as a triangle. The surge triangle was first assumed to take place at the beginning of the October-to-March period. The hourly surge heights over the surge duration were added to the hourly tide heights and the maximum values were retained in the computer memory. The surge distribution was advanced 1 hour and the process was repeated through the October-to-March period. This procedure is similar to that employed to combine tsunamis and astronomical tides (References 5 and 13). A cumulative histogram of the resulting heights was produced, and the fraction of all heights above a certain value was multiplied by the corresponding surge probability. This was done for four surge heights, and the resulting curves were plotted on probability paper. An enveloping curve was then drawn to give the stillwater level probability curve. This procedure was repeated for the three wind direction classes. The three direction curves were statistically combined to give the final stillwater elevation-frequency curve.

Waves of various heights, periods, and directions for the various recurrence intervals were tracked from the deepwater locations (Reference 14) to shore using a wave refraction and shoaling program called WAVES 2, which is a modified version of a program called WAVES (Reference 15). The required data for this program were ocean bottom topography and wave height, period, direction, and starting location.

After tracking the wave to the shoreline, calculations specified in the U.S. Army Corps of Engineers Shore Protection Manual (Reference 6) were used to compute wave setup and wave runup. The effective beach slope values employed in the runup computations were obtained by matching surge and wave hindcasts to open-coast high-water marks. The values of wave runup for certain recurrence intervals were added to the stillwater levels of the same recurrence intervals to obtain open-coast, sea-surge-tide elevation-frequency curves.

The wave runup swell was similarly computed and added to an astronomical tide-height value. The probability of this total elevation was obtained by multiplying the probability of tide-height occurrence from the cumulative tide histogram by the probability of the swell wave-runup occurrence. This was done for several tide heights and runup values, and the points were plotted on probability paper. The resulting swell-tide curves were statistically combined with the sea-surge tide curves to obtain the final open-coast flood elevation-frequency curves. This procedure for combining the effects of sea and swell was done for several beach slopes. The difference between the total combined frequency curve and the sea-surge-tide frequency curve correlated quite well with effective beach slope. This correlation was employed to compute the total open-coast flood elevation-frequency curves from the remaining sea-surge-tide curves.

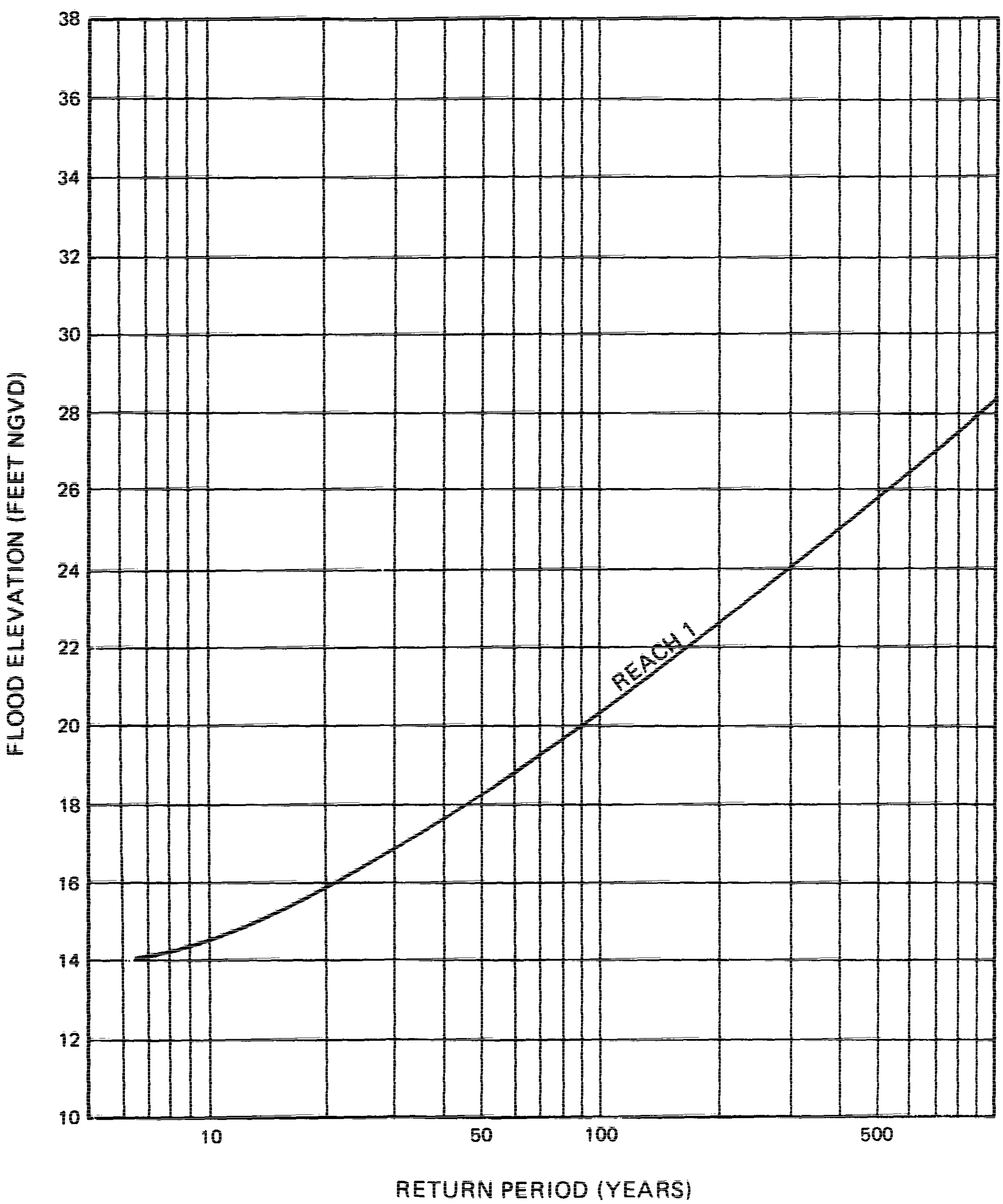
All combinations of coastal flood components (excluding tsunamis) are included in the elevation-frequency curve shown in Figure 3.

It was determined that the 100-year flood from the Pacific Ocean would cause shallow flooding of a 1.0-foot depth at various locations throughout the city, but the 500-year flood from the Pacific Ocean would cause shallow flooding of less than 1.0 foot in almost all of the rest of the city.

In the City of Gearhart (north of Seaside), east of Oregon Coast Highway 101, flood levels rise in combination with the increase in elevation of Neawanna Creek. This water backs up southward through Clatsop County, flooding the area in Seaside, east of Wahanna Road and north of Broadway. The elevation-frequency curve for this flooding is shown in Figure 4.

Analyses of the hydraulic characteristics of streams in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each stream studied in the community.

Field surveys were made to acquire stream channel profiles, cross sections, and high-water mark elevations from the December 21, 1972, flood for 12.8 miles on the Necanicum River, 4.2 miles on Neawanna Creek, and 4.1 miles on Circle Creek. The field surveys began in May 1971 and interviews with local residents on high-water marks were completed during the summer of 1974.



FLOOD ELEVATION FREQUENCY CURVE

PACIFIC OCEAN AT SEASIDE

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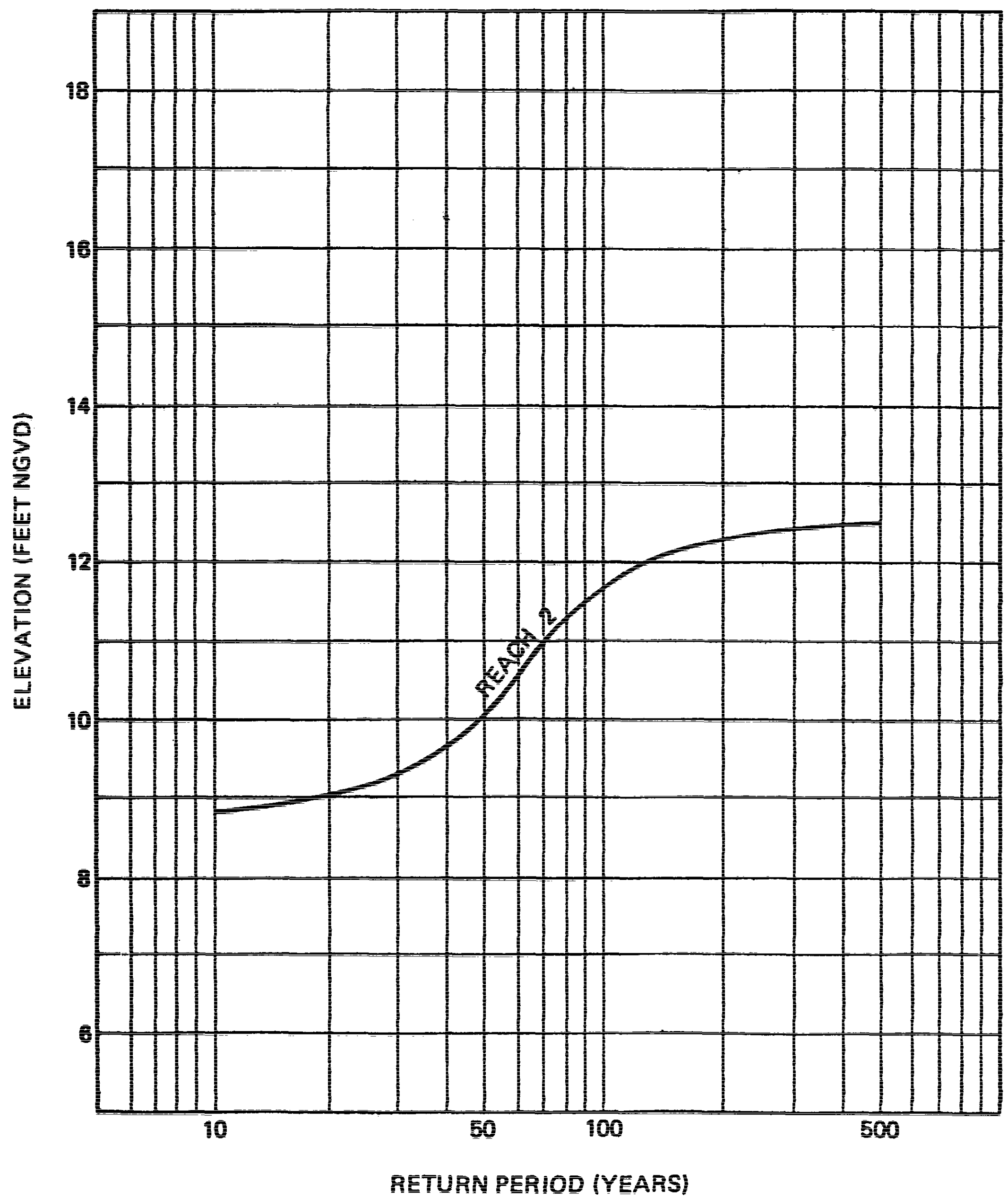
FIGURE 3



FLOOD ELEVATION FREQUENCY CURVE

NEAWANNA CREEK

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FIGURE 4

Cross sections were located at close intervals above and below bridges, culverts, and tributary confluences.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Analyses for water-surface profiles were done with the U.S. Soil Conservation Service WSP2 computer program (Reference 16). A trial-and-error process using the water-surface profile program was done until the calculated water-surface elevations for the estimated December 21, 1972, peak flow matched the observed high-water marks. Estimated discharges for the various frequency floods were then used to obtain water-surface elevations at each cross section for these floods. Starting elevations from an estimated highest possible tide, mean high high water, and mean high water were used to show the effect of tides on the lower reaches of the Necanicum River. Starting elevations for Neawanna Creek and Circle Creek were taken at their confluences with the Necanicum River.

Channel roughness factors (Manning's "n") were determined by field inspection at each cross section and ranged from 0.030 to 0.150 for both the channel and the overbank areas.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

Water-surface profile computations at bridges are based on present normal bridge openings. Consideration was not given either to the possible blockage of bridge openings by sediment and debris or to future bridge enlargement.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used int he study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage State and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Insurance Administration as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each flooding source studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at scale of 1:1200, with a contour interval of 2 feet (Reference 17).

For each coastal area studied in detail, the boundaries of the 100- and 500-year floods have been delineated by considering ground elevation contours shown on topographic maps (Reference 17) and water-surface elevations or depths. Areas inundated by the 100-year flood that have additional hazards due to wave action also have been delineated.

Where wave runup from the 100-year flood has breached the primary dune line, the water flow down the back side of the dune was designated as an AO (sheet flow) zone.

In cases where the 100- and 500-year flood boundaries are close together, only the 100-year flood boundary has been shown.

Flood boundaries for the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2).

Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity and increases flood heights, thus increasing flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment in order that the 100-year flood be carried without substantial increases in flood heights. As minimum standards, the Federal Insurance Administration limits such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

The floodway for this study was computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 1).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood boundaries are close together, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 5.

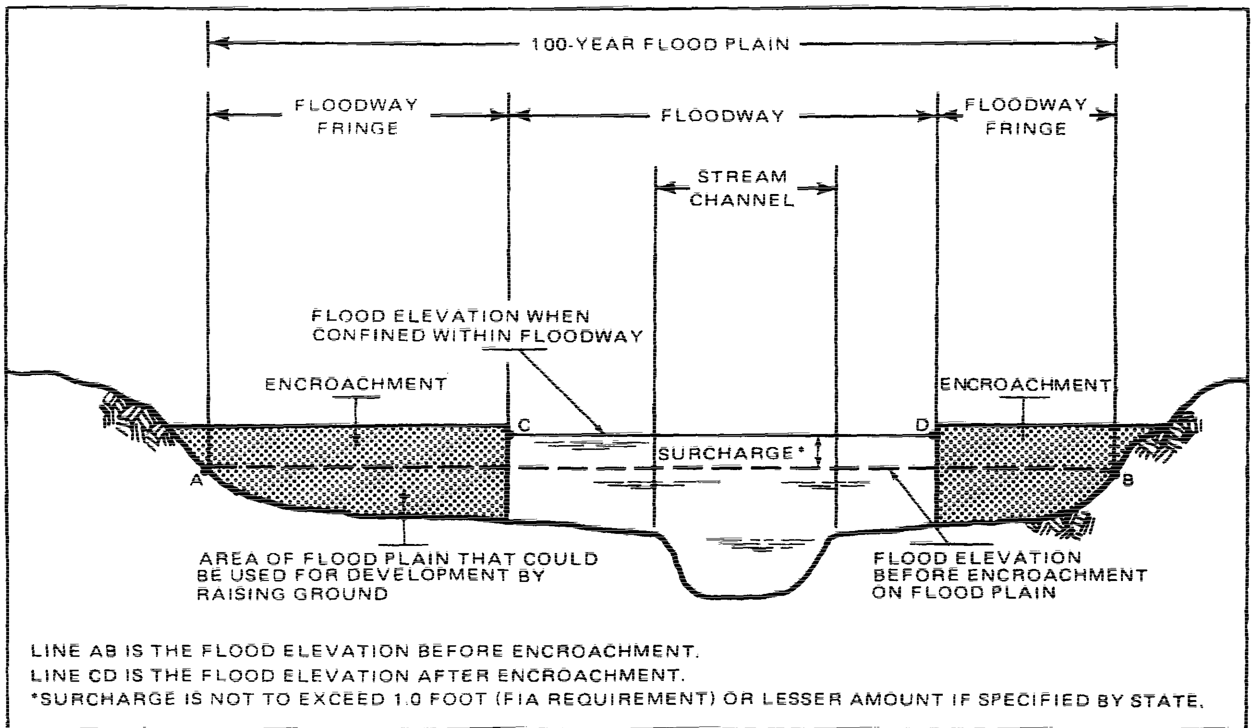

Figure 5. Floodway Schematic

A floodway is not appropriate for areas affected by either ocean or coastal flooding. Thus, no floodway was prepared for the coastal area of Seaside.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WITH FLOODWAY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	DIFFERENCE
Neawanna Creek							
A	3,537	112[3]	2,500.0	2.0	11.7	11.0	0.7
B	3,696	120[3]	892.9	5.6	11.7	11.4	0.3
C	3,854	117[3]	1,428.5	3.5	12.1	11.8	0.3
D	6,283	130[3]	2,173.9	2.3	12.7	11.9	0.8
E	7,550	214/55[2]	2,777.8	1.8	12.7	12.0	0.7
F	7,761	215/85[2]	2,833.3	1.8	12.7	12.2	0.5
G	9,134	313/35[2]	4,636.4	1.1	12.7	12.2	0.5
H	10,771	152	2,428.6	2.1	12.7	12.3	0.4
I	10,982	185	2,550.0	2.0	13.1	12.5	0.6
J	12,936	480/20[2]	3,785.7	1.4	13.7	12.7	1.0
K	14,203	270[3]	2,650.0	2.0	13.8	12.8	1.0
L	15,523	300/50[2]	2,571.4	2.1	13.8	12.8	1.0
Circle Creek							
A	2,745	520	1,757.6	3.3	17.4	16.4	1.0
B	5,438	2,391/ 1,800[2]	11,750.0	0.8	18.1	17.1	1.0
C	5,544	2,020/ 1,500[2]	11,750.0	0.8	18.1	17.1	1.0
D	6,705	1,600/ 1,350[2]	11,000.0	0.8	18.3	17.3	1.0
E	9,292	1,360	4,250.0	2.0	20.5	19.5	1.0
F	13,358	890/820[4]	1,000.0	4.5	25.8	24.8	1.0
G	14,467	300	1,046.9	6.4	29.4	28.4	1.0
H	15,153	260/200[2]	1,000.0	6.7	30.4	29.4	1.0

[1] Feet Above Mouth
[2] Width/Width Within Corporate Limits
[3] Floodway Lies Entirely Outside Corporate Limits
[4] Combined F/W Width of Circle Creek and Necanicum River/Width Within Corporate Limits

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FLOODWAY DATA

NEAWANNA CREEK-CIRCLE CREEK

TABLE 1

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WITH FLOODWAY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	DIFFERENCE
Necanicum River							
A	6,600	360	3,785.7	2.8	10.8	10.8	0.0
B	6,969	310	3,000.0	3.5	11.1	11.1	0.0
C	9,081	283	2,729.7	3.7	11.4	11.2	0.2
D	9,715	220	2,325.6	4.3	11.7	11.3	0.4
E	10,137	183	1,980.0	5.0	11.7	11.4	0.3
F	10,401	177	2,675.7	3.7	12.2	12.0	0.2
G	11,246	250	3,161.3	3.1	13.0	12.0	1.0
H	11,457	230	3,266.7	3.0	13.0	12.3	0.7
I	13,200	247	2,939.4	3.3	13.4	12.4	1.0
J	14,889	113/10[2]	1,684.2	5.7	14.3	13.5	0.8
K	15,259	335/125[2]	4,000.0	2.4	15.3	14.4	0.9
L	17,107	210	1,321.4	7.0	16.3	15.3	1.0
M	17,899	2,650/2,500[2]	10,875.0	0.8	16.3	15.3	1.0
N	19,905	2,340/1,460[2]	2,629.6	2.7	17.3	16.3	1.0
O	22,862	760/240[2]	1,000.0	5.8	17.4	16.9	0.5
P	23,707	310/300[2]	840.6	6.9	18.8	17.8	1.0
Q	24,552	550	2,640.0	2.5	20.0	19.0	1.0
R	27,244	175/100[2]	1,180.3	6.1	22.1	21.6	0.5

[1]Feet Above Mouth [2]Width/Width Within Corporate Limits

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FLOODWAY DATA

NECANICUM RIVER

TABLE 1

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Insurance Administration has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting the City of Seaside.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses or waterbodies having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot

Seven reaches meeting the above criteria were required for the flooding sources of Seaside. These included one each for Circle Creek and the Pacific Ocean, two for Neawanna Creek, and three for Necanicum River. The locations of the riverine reaches are shown on the Flood Profiles (Exhibit 1).

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is the Federal Insurance Administration device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective Flood Hazard Factors, the entire incorporated area of the City of Seaside was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A0:	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown, but no Flood Hazard Factors are determined.
Zones A1, A2, A3, and A6:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to Flood Hazard Factors.
Zone V12:	Special Flood Hazard Area along coasts inundated by the 100-year flood, determined by detailed methods, and that have additional hazards due to velocity (wave action); base flood elevations shown, and zones subdivided according to Flood Hazard Factors.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

The flood elevation differences, Flood Hazard Factors, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 2.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Necanicum River							
Reach 1	0005	-0.35	-0.09	+0.22	005	A1	Varies - See Map
Reach 2	0005	-0.84	-0.23	+0.58	010	A2	Varies - See Map
Reach 3	0005	-0.42	-0.13	0.27	005	A1	Varies - See Map
Neawanna Creek							
Reach 1	0005	-0.92	-0.19	0.40	010	A2	Varies - See Map
Reach 2	0005	-3.00	-1.80	0.70	030	A6	12
Circle Creek							
Reach 1	0005	-1.73	-0.51	1.41	015	A3	Varies - See Map
Pacific Ocean							
Reach 1	0005	-5.80	-2.10	5.40	060	V12	20
Shallow Flooding	0005	N/A	N/A	N/A	N/A	A0	Depth 1

[1] Flood Insurance Rate Map Panel [2] Weighted Average [3] Rounded to Nearest Foot

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TABLE 2

FLOOD INSURANCE ZONE DATA

NECANICUM RIVER-NEAWANNA CREEK-CIRCLE CREEK-PACIFIC OCEAN-SHALLOW FLOODING

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Seaside is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the Federal Insurance Administration.

6.0 OTHER STUDIES

In 1976, the U.S. Soil Conservation Service completed a flood hazard analysis on the Necanicum River (Reference 18), which included the City of Seaside. It identified and delineated the flood hazard areas and floodway along 12.5 miles of the Necanicum River, 4.1 miles of Neawanna Creek, 3.8 miles of Circle Creek, and 0.3 mile of Beerman Creek. These areas drain through Seaside. That study was the basis for this Flood Insurance Study; therefore, they are in agreement.

A Flood Insurance Study has been prepared for Clatsop County, Oregon (Reference 1), and is in basic agreement with this study. However, the floodway widths for the stream sections which are both in Seaside and Clatsop County do not agree exactly due to different methods for floodway computations used in Seaside and Clatsop County.

This study is authoritative for the purposes of the National Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Federal Insurance Administration, Regional Director, Arcade Plaza Building, 1321 Second Avenue, Seattle, Washington 98101.

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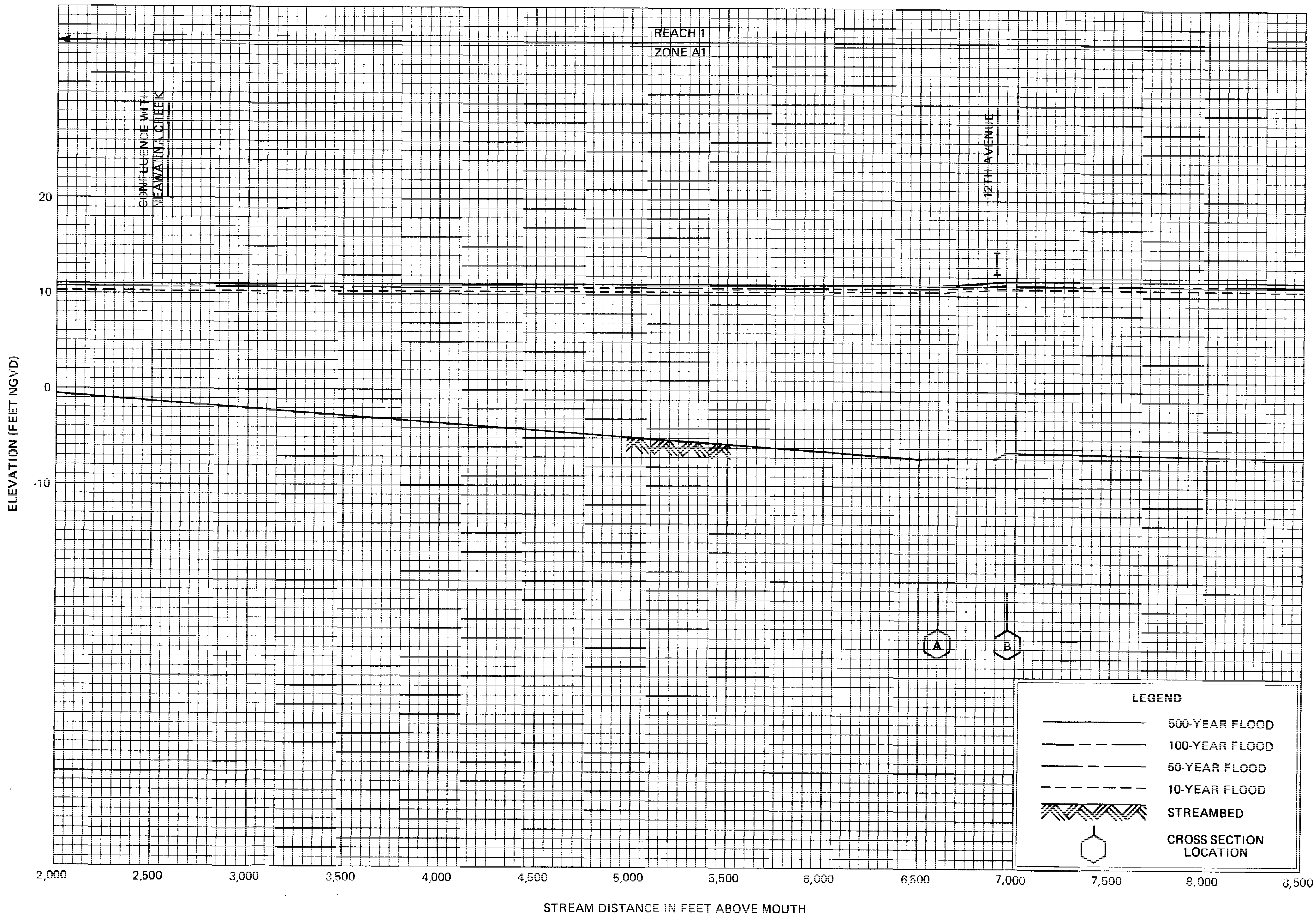

FLOOD PROFILES

NECANICUM RIVER

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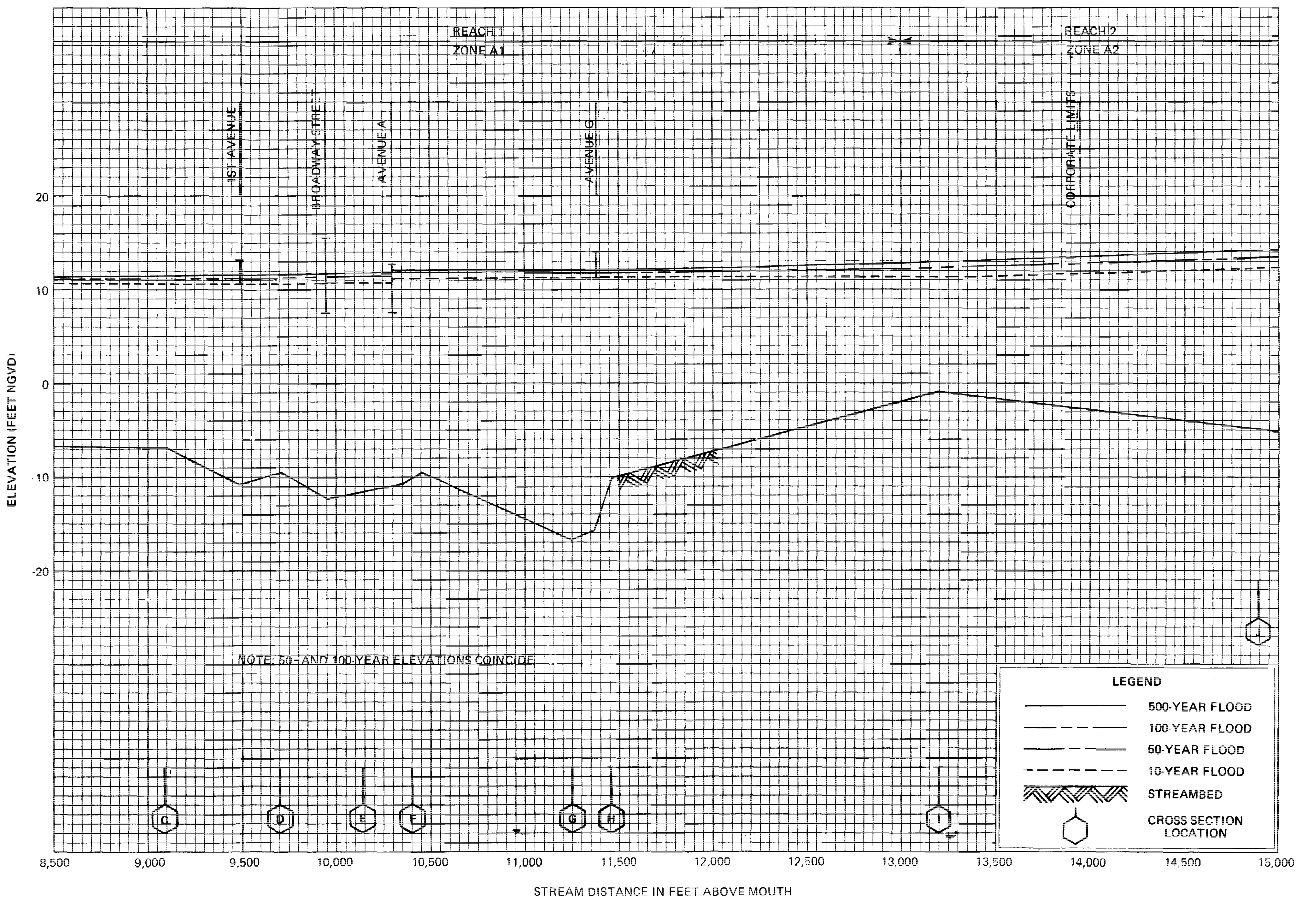

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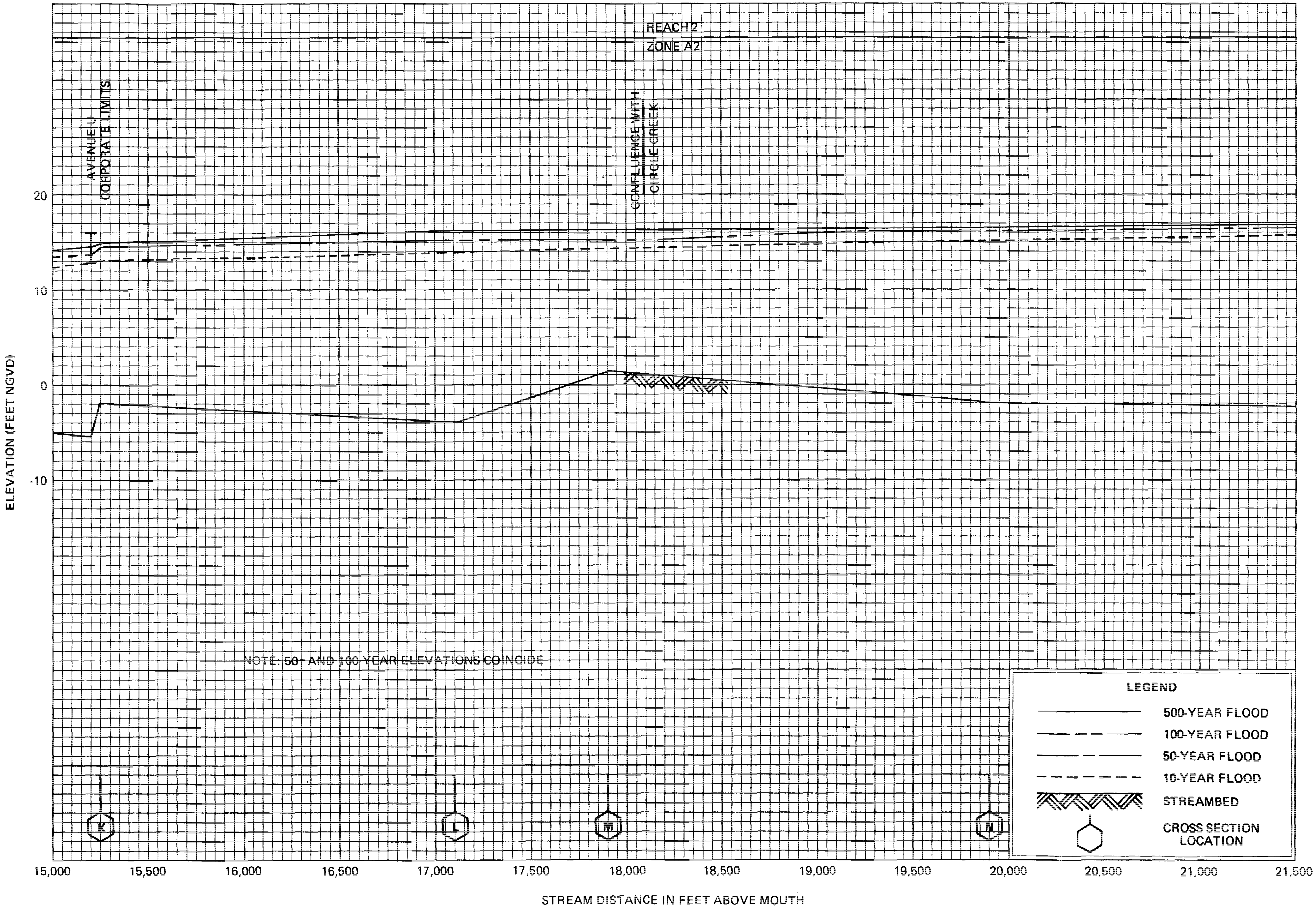

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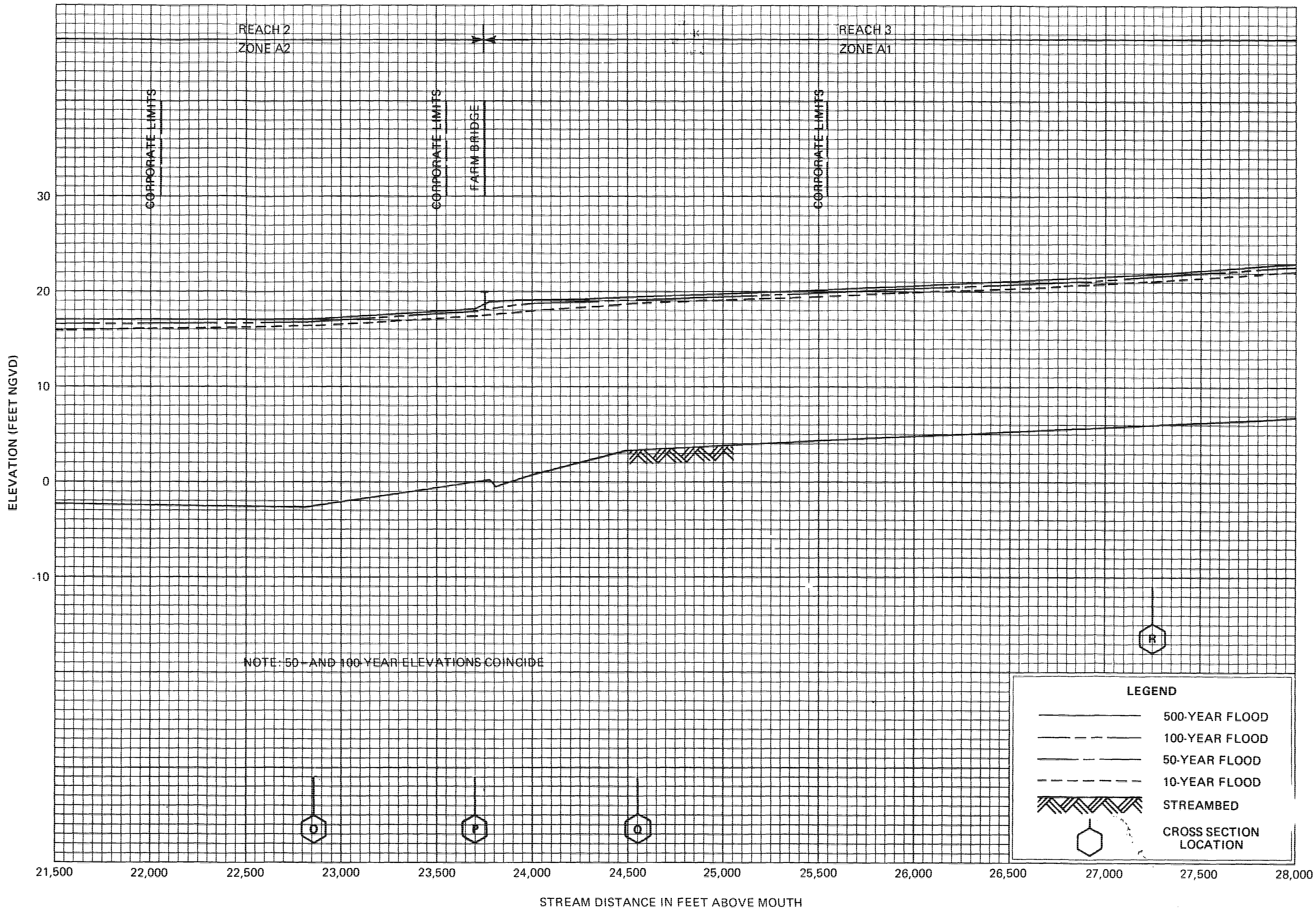

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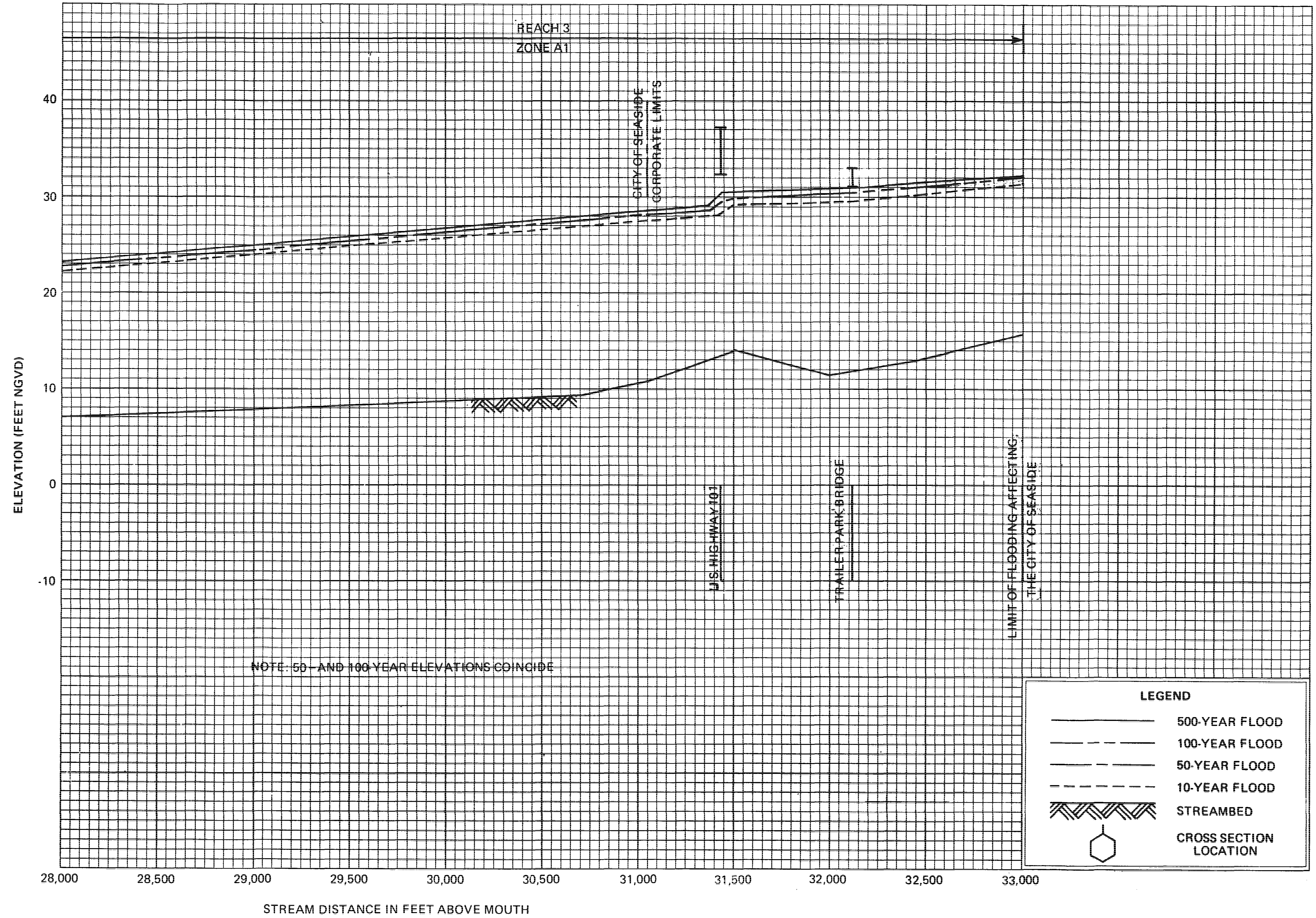

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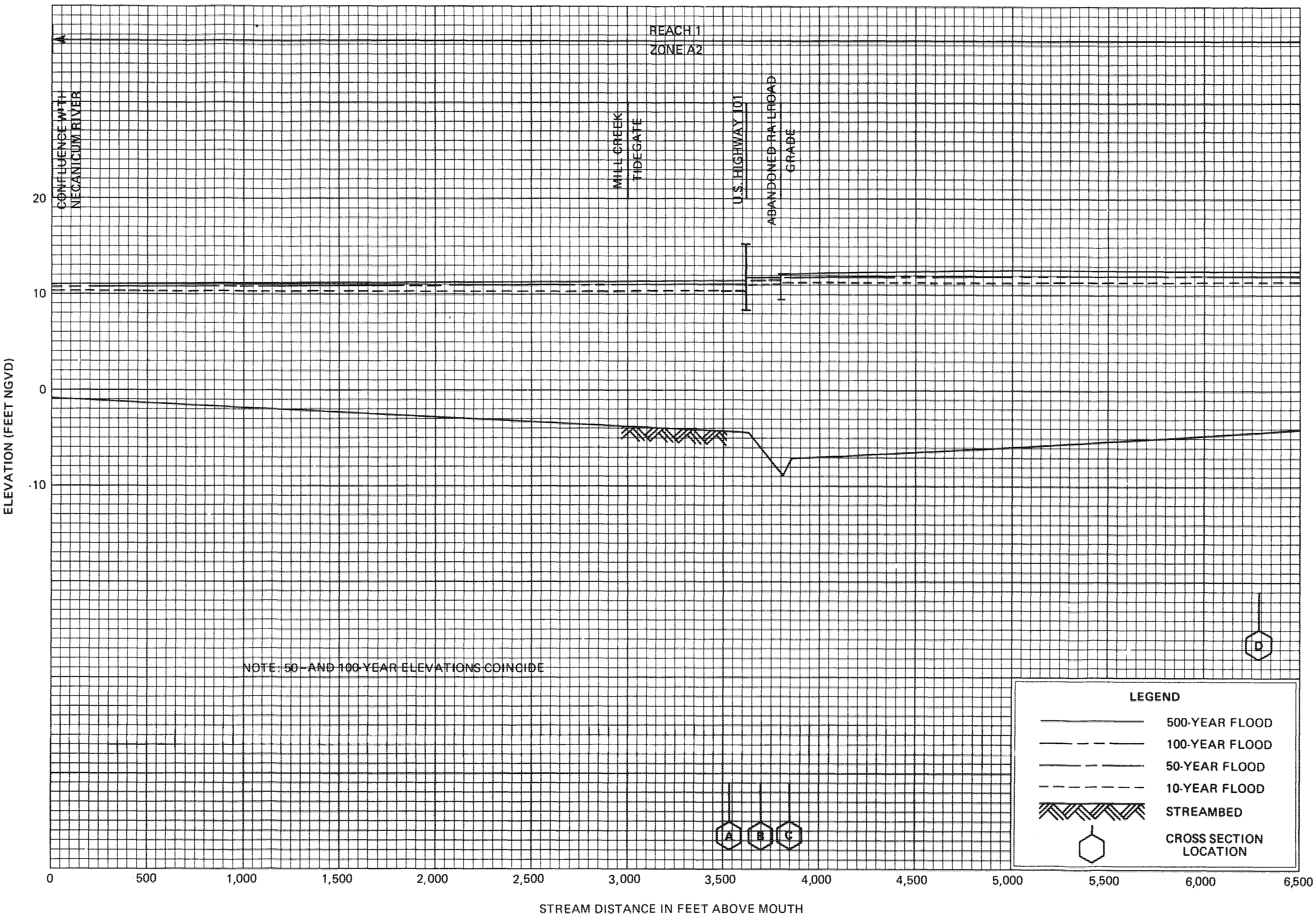

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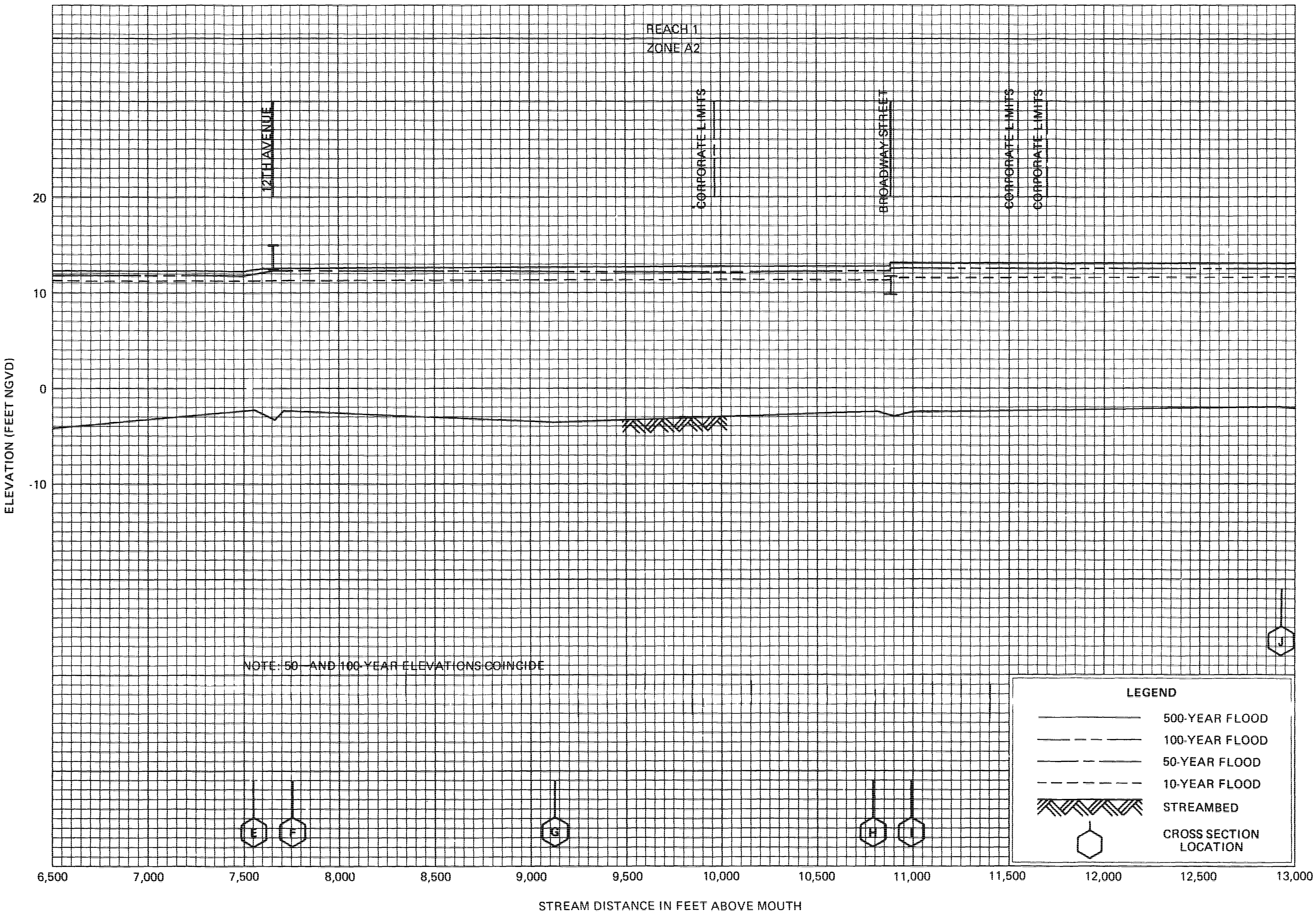

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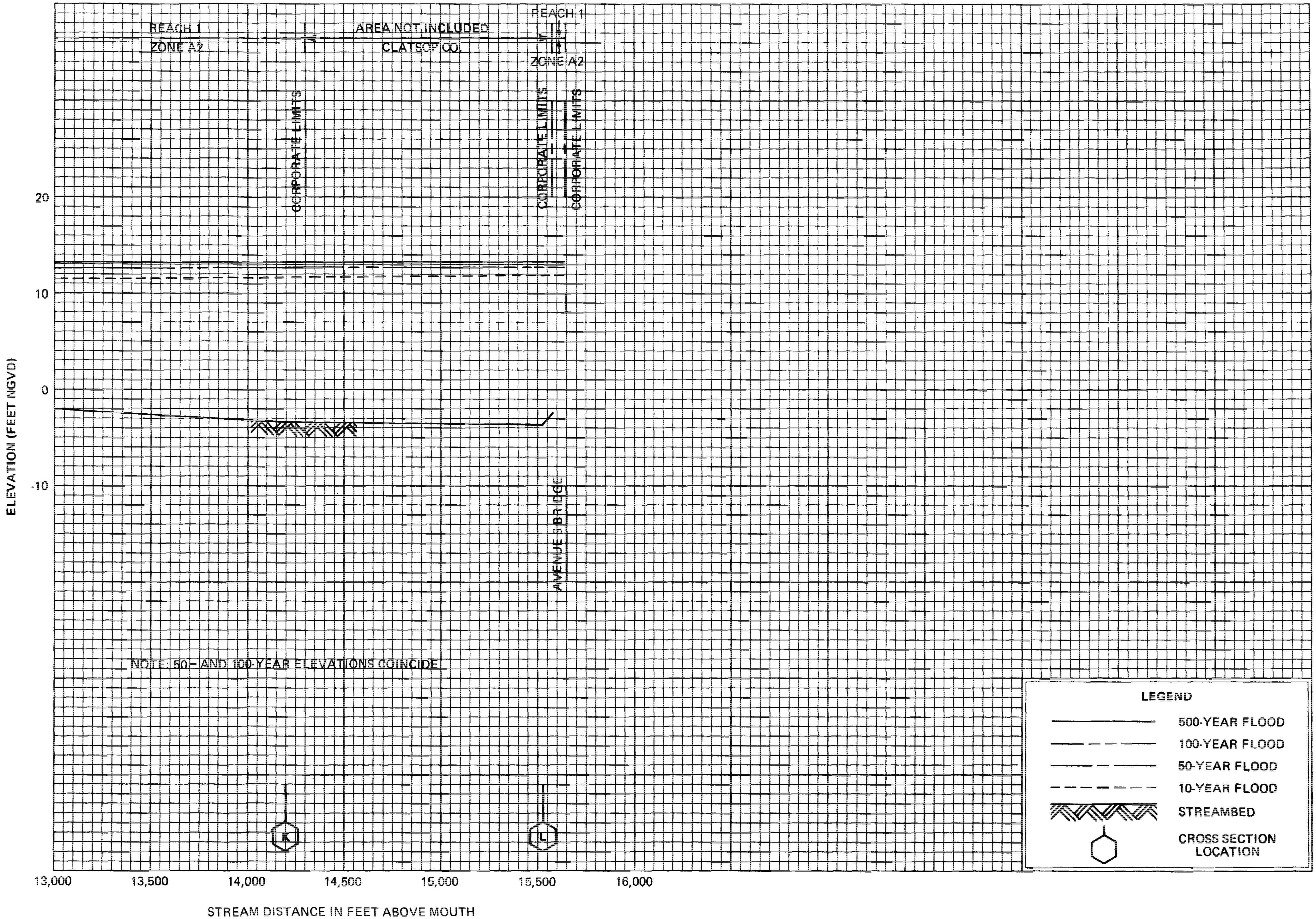

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FLOOD PROFILES

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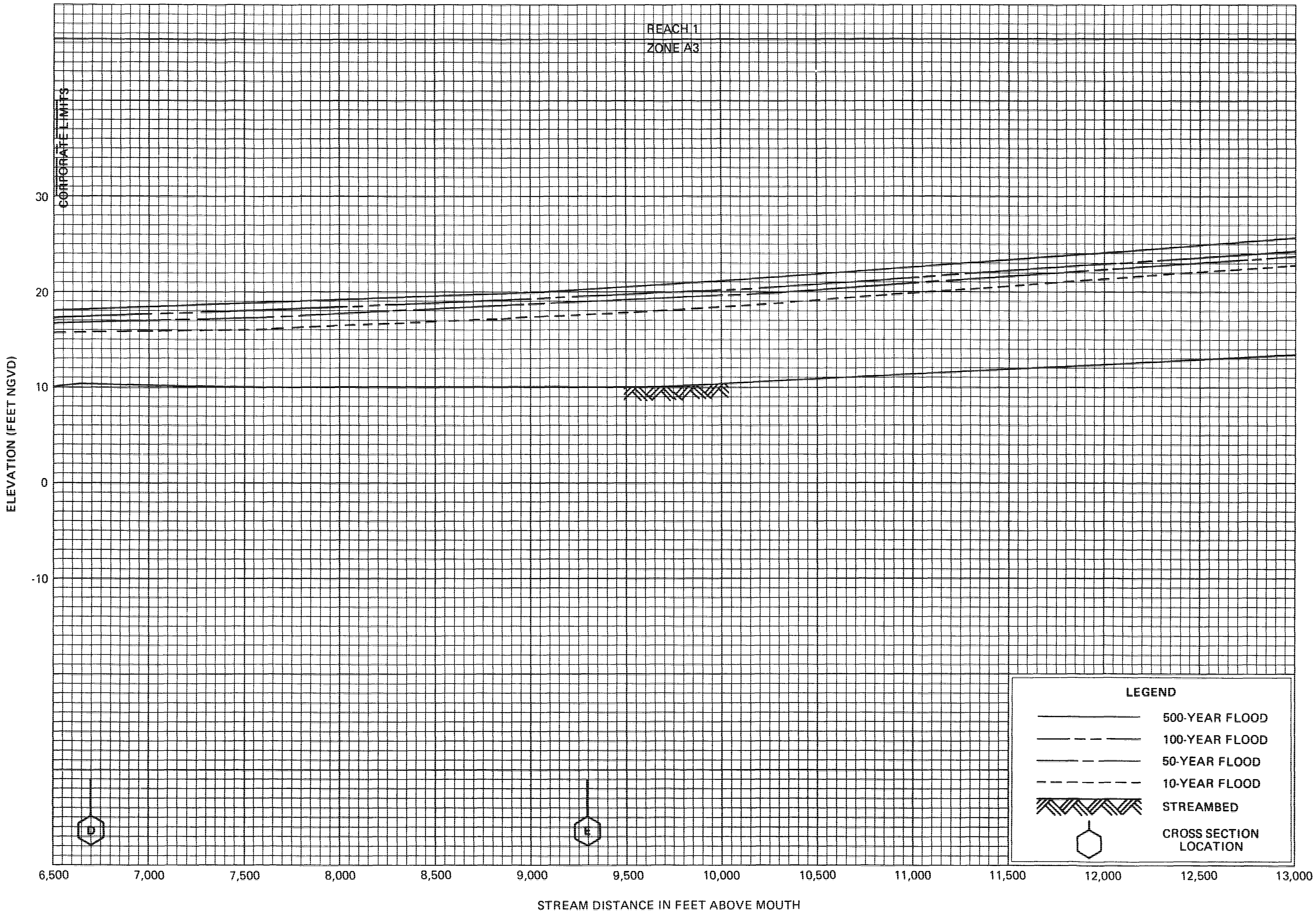

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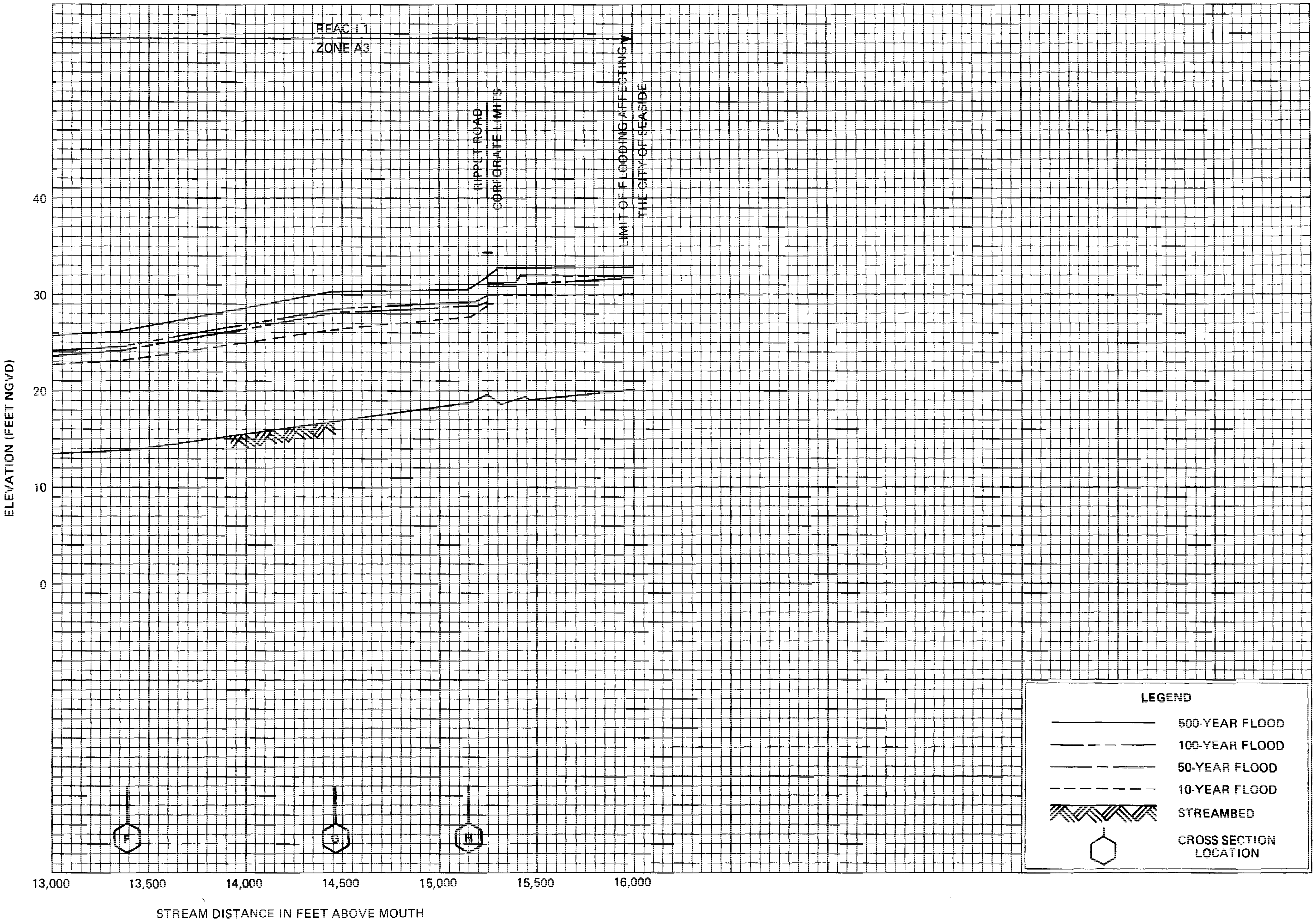

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